Problem 1.
The goal of this Laboratory is to make you feel comfortable using MASTAN2 (MAtrix STruc-
tural ANalysis 2) to analyze various structural systems. Go through the tutorial (execute
the following commands: cd "cee361ta/mastan2 & acroread tutorial.pdf) and follow the steps
to do the two-bay single story frame using MASTAN2. Note that you also have the tutorial
file available in the disk which accompanies the textbook. Perform only "1st-Order Elastic"
analysis and submit one plot of the moment diagram of the structure.

Problem 2.
Generate the gable frame of LABORATORY #3, Problem 1, using the preprocessing ca-
pabilities of MASTAN2, perform “1st-Order Elastic” analysis, and submit one plot of the
deformed shape of the structure and another plot of its moment diagram (postprocessing)
total of two plots for this problem).

Problem 3.
Generate the three-dimensional frame shown below (preprocessing), perform “1st-Order Elas-
tic” analysis considering the applied load and the support settlement. Submit a report with
the following information: "General Info," "Geometry," "Properties," "Conditions," "Dis-
placements," "Element Results," and "Reactions". Also submit a Diagram with the “De-
flected shape,” and one (and only one) additional plot (... to save your pint-quota) of one
of the following “Diagrams” (postprocessing) of your own choice: “Deflected shape,” “Axial
Force,” “Shear Y,” “Shear Z,” “Torque,” “Moment Y,” or “Moment Z.”

- For the diagram with the deflected shape, show the orientation of the “Element Web
(Local-y).” For all the other diagrams, eliminate non-relevant information such as
“Node #s,” “Element #s,” “Loads,” “Fixities,” and “Settlements.” Make sure that
all the diagrams fit in the window and that the diagram values are as readable as
possible.

- The torsion constant J (e.g. in previous courses you might have seen that J is equal to
the polar moment of inertia in the special case of a circular, cylindrical shaft), which
is a geometric property of the cross section, can be approximated as follows:

\[ J = \frac{1}{3} (2bf \ t_f^3 + h \ t_w^3) \]

where \( h = (d - t_f) \) and the notation is explained on the attached pages listing the
“Properties of Structural Members.”
Figure for Problem 2

\[ w = 0.10 \text{ k/in} \]

Member Properties

1 & 4
\[ A = 40 \text{ in}^2 \]
\[ I = 4000 \text{ in}^2 \]

2 & 3
\[ A = 30 \text{ in}^2 \]
\[ I = 6000 \text{ in}^2 \]

For all members, \( E = 30,000 \text{ ksi} \)

Figure for Problem 3

Material

\[ E = 29,000 \text{ ksi} \]
\[ v = 0.3 \]

Sections

Columns: W14x82
All Others: W12x50

Support Settlement

\[ \Delta X = -2.0'' \]
\[ \Delta Y = 1.5'' \]
## APPENDIX C

### PROPERTIES OF STRUCTURAL STEEL MEMBERS

#### Table C.1a  Properties of W shapes (wide-flange sections) (U.S. customary units)

<table>
<thead>
<tr>
<th>Designation*</th>
<th>Area A, in²</th>
<th>Depth d, in.</th>
<th>Width b₁, in.</th>
<th>Thickness t₁, in.</th>
<th>Web thickness t₂, in.</th>
<th>Axis X–X</th>
<th>Axis Y–Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>W36 × 300</td>
<td>88.3</td>
<td>36.74</td>
<td>16.655</td>
<td>1.680</td>
<td>0.945</td>
<td>20300</td>
<td>1110</td>
</tr>
<tr>
<td>W33 × 201</td>
<td>59.1</td>
<td>33.68</td>
<td>15.745</td>
<td>1.150</td>
<td>0.715</td>
<td>11500</td>
<td>684</td>
</tr>
<tr>
<td>W118</td>
<td>34.7</td>
<td>32.86</td>
<td>11.480</td>
<td>0.740</td>
<td>0.550</td>
<td>5900</td>
<td>359</td>
</tr>
<tr>
<td>W20 × 173</td>
<td>16.0</td>
<td>24.8</td>
<td>14.985</td>
<td>1.065</td>
<td>0.655</td>
<td>3990</td>
<td>269</td>
</tr>
<tr>
<td>W27 × 146</td>
<td>12.8</td>
<td>27.38</td>
<td>13.965</td>
<td>0.975</td>
<td>0.605</td>
<td>5630</td>
<td>411</td>
</tr>
<tr>
<td>W24 × 104</td>
<td>9.7</td>
<td>26.71</td>
<td>9.900</td>
<td>0.640</td>
<td>0.460</td>
<td>2850</td>
<td>213</td>
</tr>
<tr>
<td>W21 × 101</td>
<td>7.5</td>
<td>23.73</td>
<td>12.750</td>
<td>0.750</td>
<td>0.500</td>
<td>3100</td>
<td>258</td>
</tr>
<tr>
<td>W18 × 106</td>
<td>5.5</td>
<td>21.56</td>
<td>8.965</td>
<td>0.585</td>
<td>0.415</td>
<td>1830</td>
<td>154</td>
</tr>
<tr>
<td>W16 × 77</td>
<td>4.0</td>
<td>19.99</td>
<td>12.290</td>
<td>0.800</td>
<td>0.500</td>
<td>2420</td>
<td>227</td>
</tr>
<tr>
<td>W14 × 70</td>
<td>3.2</td>
<td>18.05</td>
<td>8.240</td>
<td>0.615</td>
<td>0.400</td>
<td>1330</td>
<td>127</td>
</tr>
<tr>
<td>W14 × 70</td>
<td>0.89</td>
<td>17.92</td>
<td>6.500</td>
<td>0.450</td>
<td>0.350</td>
<td>843</td>
<td>81.6</td>
</tr>
<tr>
<td>W14 × 70</td>
<td>145</td>
<td>14.78</td>
<td>16.475</td>
<td>2.600</td>
<td>1.655</td>
<td>5440</td>
<td>607</td>
</tr>
<tr>
<td>W14 × 70</td>
<td>145</td>
<td>14.78</td>
<td>15.500</td>
<td>1.090</td>
<td>0.680</td>
<td>1710</td>
<td>232</td>
</tr>
<tr>
<td>W14 × 70</td>
<td>145</td>
<td>14.78</td>
<td>10.130</td>
<td>0.855</td>
<td>0.510</td>
<td>582</td>
<td>123</td>
</tr>
<tr>
<td>W14 × 70</td>
<td>145</td>
<td>14.78</td>
<td>10.035</td>
<td>0.720</td>
<td>0.415</td>
<td>723</td>
<td>103</td>
</tr>
<tr>
<td>W14 × 70</td>
<td>145</td>
<td>14.78</td>
<td>7.995</td>
<td>0.530</td>
<td>0.305</td>
<td>541</td>
<td>77.8</td>
</tr>
<tr>
<td>W14 × 70</td>
<td>145</td>
<td>14.78</td>
<td>6.770</td>
<td>0.515</td>
<td>0.310</td>
<td>385</td>
<td>54.6</td>
</tr>
<tr>
<td>W14 × 70</td>
<td>145</td>
<td>14.78</td>
<td>6.730</td>
<td>0.385</td>
<td>0.270</td>
<td>291</td>
<td>42.0</td>
</tr>
<tr>
<td>W14 × 70</td>
<td>145</td>
<td>14.78</td>
<td>5.025</td>
<td>0.420</td>
<td>0.255</td>
<td>245</td>
<td>35.3</td>
</tr>
<tr>
<td>W14 × 70</td>
<td>145</td>
<td>14.78</td>
<td>5.000</td>
<td>0.335</td>
<td>0.230</td>
<td>199</td>
<td>29.0</td>
</tr>
</tbody>
</table>

* A wide-flange section is designated by the letter W followed by the nominal depth in inches and the weight in pounds per foot.

Source for all tables in Appendix C: Manual of Steel Construction, American Institute of Steel Construction.
### Table C.1a  Properties of W shapes (wide-flange sections) (U.S. customary units)

(Continued from page C1)

<table>
<thead>
<tr>
<th>Designation*</th>
<th>Area $A$, in$^2$</th>
<th>Depth $d$, in.</th>
<th>Flange Width $b_f$, in.</th>
<th>Thickness $t_f$, in.</th>
<th>Web thickness $t_w$, in.</th>
<th>Axis X-X</th>
<th>Axis Y-Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>W12 × 96</td>
<td>28.2</td>
<td>12.71</td>
<td>12.160</td>
<td>0.900</td>
<td>0.550</td>
<td>833</td>
<td>131</td>
</tr>
<tr>
<td>W10 × 112</td>
<td>32.9</td>
<td>11.36</td>
<td>10.415</td>
<td>1.250</td>
<td>0.755</td>
<td>716</td>
<td>126</td>
</tr>
<tr>
<td>W8 × 58</td>
<td>17.1</td>
<td>8.75</td>
<td>8.220</td>
<td>0.810</td>
<td>0.510</td>
<td>228</td>
<td>52.0</td>
</tr>
</tbody>
</table>

* A wide-flange section is designated by the letter W followed by the nominal depth in inches and the weight in pounds per foot.